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Patentanmeldung Nr. Patent application No. Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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Tree stump grinder

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TREE STUMP GRINDER

The present invention relates to tree stump grinding machines and particularly to the grinding wheel and associated tooth design.

It is known in the prior art to provide a tree stump grinding machine with a cutting wheel driven by a belt, a chain, shafts or hydraulic motors. Current stump grinding machines consist of a, typically circular, wheel with a number of receiving brackets positioned around the rim. The receiving brackets have channels into which are fitted individual cutting teeth. Each tooth is individually mounted and a gauge is often required to set each tooth at the correct distance from the centre of the wheel. Each tooth is held in place by retaining bolts that are tightened to a very high degree in order to hold the teeth. The bolts and retaining brackets are required to take the full rotational force of the grinding action. The wheel is provided with a plurality of teeth, some of which are fitted to cut vertically while others are fitted to cut horizontally, as the wheel moves along a horizontal and vertical axis. An example of such a grinding wheel is found in US-B-6484766.

The teeth and receiving brackets provided on the grinding wheels known from the prior art have to be changed regularly as a result of the considerable wear that they encounter in use. Changing the teeth and receiving brackets is time consuming because of the set up accuracy required. Each tooth is generally held in place using two bolts to secure the receiving bracket and the tooth. The task of changing the teeth is invariably complicated by the earth and mud that clogs the teeth, brackets and bolt threads which then require cleaning prior to fitting of a new tooth. As a result of the earth and mud, the receiving thread in the cutting wheel and the bolt or bolts may become cross-threaded and require repair before a new tooth can be fitted. In addition to the expense incurred in a long down-time to change the teeth, the teeth and receiving brackets themselves are expensive because of the number of heavy duty components.

In order to overcome the disadvantages of the prior art there is provided, in accordance with the present invention, a grinding unit for use with a grinding machine, the unit comprising:

a rotor having a rim around which a plurality of slots are provided;

a plurality of teeth, each tooth having a slot for engagement with one of the slots in the rotor; and

fixing means for retaining each tooth in its associated slot in the rotor.

The provision of co-operating slots on the teeth and rotor rim obviate the need for precise set-up required by the grinding units of the prior art. Furthermore, the fixing means is required only to retain the tooth in place as the wheel itself absorbs a substantial proportion of the forces in the plane of the rotor resulting from the grinding action.

The radius of the rotor may vary around the circumference. In particular the shape of the rotor may be that of a polygon that may be irregular. Preferably the rotor has an even number of sides and preferably there is a slot provided at each corner of the polygon.

The polygonal shape of the rotor allows the teeth to be positioned at different distances from the axis of rotation of the rotor. A rotor with an even number of sides is preferable as it facilitates easy balancing of the wheel. If the slots were not provided at the corners of the polygon, there would be sections of the polygon extending further than the teeth and these would, in use, impact on the stump to be ground, causing damage to the grinding unit.

Preferably the slots are arranged in diametrically opposed pairs wherein the slots in an opposing pair of slots are the same distance from the axis. Preferably, the slots are arranged in two diametrically opposed series, each successive slot in each series having an increased distance from the axis.

The arrangement of the slots in diametrically opposed pairs equidistant from the axis of the rotor allows the rotor to be more easily balanced. Furthermore, this allows two series of teeth to be developed each covering 180° of the rotor. The teeth are located in the slots at the corners of the rotor and therefore, as a result of the differences in circumference of the rotor different teeth extend different distances from the axis of rotation of the rotor. As a result of the two diametrically opposed series, the stump is, in use, successively ground by teeth that extend further from the axis. If such a sequence of tooth diameters is used then it is clear that there is one correct direction of rotation for the rotor. The teeth that extend furthest from the axis do more of the cutting and those set further in towards the axis act as restrictors. This configuration of teeth also enables a sideways or slew cut to be achieved.

The number of slots is preferably 4, 6, 8, 10 or 12. Some or all of the slots may be angled either towards or away from the axis of rotation of the rotor. If the slots are angled towards the axis of rotation, the teeth will protrude perpendicular to the rim of

the rotor and therefore, dependent on the configuration of the cutting tips of the teeth, the rotor could be rotated in either direction. However, if the slots are angled away from the axis of rotation the teeth will protrude at an angle. In this case, the rotor will function correctly with only one direction of rotation. This is particularly useful in the case when the slots have been configured such that the tree stump is ground with teeth that protrude progressively further from the axis of rotation over a range of 180°.

Furthermore, according to the present invention, there is provided a tooth for use with a grinding rotor, the tooth comprising:

a main body; and

a plurality of cutting tips connected to and extending away from the main body.

The base of the tooth is preferably made to slot precisely into the slot of the rotor which has been designed to absorb the considerable forces that exist within the plane of the rotor when the teeth are in contact with the stump. The slot design of the wheel allows for the use of a single low cost bolt to keep the tooth in place. The tooth is a multi-tipped tooth which may have protruding horizontal tips protruding horizontally in order to facilitate lateral grinding in addition to radial tips. The multi-tipped tooth allows for cutting in radial and lateral directions simultaneously.

Preferably, the plurality of cutting tips includes at least two tips which are perpendicular to each other. The main body may include a slot for, in use, engaging with a corresponding slot on a rotor. The tooth may furthermore be provided with a through hole through which a fixing means may pass, in use.

The fixing means is typically a single low cost standard bolt with a locking nut and is a "throw away" item which can be changed every time a tooth is changed. This means that there is no cleaning required and therefore the problems with cross-threading encountered in the prior art are effectively overcome.

Furthermore, according to the invention there is provided a tooth for use with a grinding wheel, the tooth comprising:

a slot for, in use, engaging with a slot in a rotor, and

at least one cutting face.

The slotted configuration of the tooth is advantageous as it can be held in position on the rotor with a simple bolt and locking nut. These items require no special tools for removing the nut and this reduces the time required for changing the teeth.

The present invention will now be further described with reference to the accompanying drawings in which:

Figure 1 shows a tree stump grinding machine incorporating a grinding unit according to the present invention and a plurality of teeth according to the present invention;

Figure 2A shows a cross-section of a rotor and Figure 2B shows the rotor fitted with a number of teeth;

Figures 3A and 3B show perspective views of a single tooth; and

Figures 4A and 4B show perspective views of a further example of a single tooth.

Figure 1 shows a grinding machine 100 comprising a support arm 10, a rotor 20 and a plurality of teeth 30. The arm 10 forms a housing for a transmission which may be a belt, chain drive shaft or hydraulic motor . The rotor 20 is caused to rotate by a driving engine 39 that transmits the power via the transmission housed in the support arm 10. The rotor 20 is attached a central hub 22 which passes through a set of bearings contained within a bearing housing 21 which is attached to the arm 10. As shown in Figures 2A and 2B, around the rim 23 of the rotor 20 are a plurality of slots 24 located on the corners of the rim. Radially inwardly of each of which there is provided a respective hole 25. The rotor 20 is octagonal, although almost any polygonal shape may be used, in particular a hexagon or decahedron. Each of the slots 24 and respective holes 25 is used to accommodate a tooth 30. A fixing bolt passes through the tooth 30 and through the hole 25 in the rotor 20 in order to secure the tooth 30 in position on the rim 23 of the rotor 20.

Figure 2A shows a cross section of the rotor 20 and Figure 2B shows the rotor 20 fitted with teeth 30. Eight teeth 30 are provided, one at each corner of the rotor 20. The irregular shape of the rotor results in the teeth 30 not being equidistant from the hub 22 of the rotor 20. The teeth are arranged in two series, each covering 180° of the rotor 20 wherein the distance of each tooth 30 from the axis of rotation is greater than the adjacent tooth in the direction in which the rotor rotates, in use. In use, the teeth 30 of the resulting rotor 20 grind a little more of the tree stump as each tooth 30 comes to make contact with the tree stump. This allows the grinding machine 100 to grind tree stumps more efficiently as a deeper side (slew) cut is achieved as the arm's cutting motion is sideways.

Figures 3A and 3B show a tooth 30 that has a body 31, a slot 32 and a plurality of cutting tips 33, 34, 35 and 36. The slot 32 has a hole 37 through which, in use, a bolt 27 passes to secure the tooth 30 onto the rotor 20. A nut 28 may be used to lock

the bolt 27 in place. Alternatively, if the hole 37 in one side of the tooth is threaded it is not necessary to use a nut 28. The slots 24 on the rotor 20 interface with the slots 32 on the teeth 30. This interface allows a large proportion of the force in the plane of the rotor to be communicated directly onto the rotor 20 rather than communicating these forces through the fixing means. The bolt does not communicate the forces and is required to prevent the tooth from being discharged through centrifugal force alone. The four tips (33 to 36) are arranged in two orthogonal pairs allowing efficient cutting in radial and lateral directions simultaneously.

As shown in Figure 3A the tooth 30 is also provided with a shallow channel 38 in the back face that allows the rotor 20 to take up forces from the tooth 30 in the lateral plane.

The through hole 37 may be provided on any part of the tooth 30 as the forces are communicated to the rotor 20 through the slots 24, 32 on the tooth 30 and the rotor 20 and the through hole 37 is not required for this function. The role of the through hole 37 in preventing the tooth from disengaging from the rotor 20 may be fulfilled regardless of the positioning of the through hole 37. Further protrusions or holes may be designed into the tooth to secure it into the rotor 20.

An alternative configuration of a tooth is shown in Figures 4A and 4B. This tooth 40 is provided with a pair of protrusions 41, 42 that extend radially along the rim. The tooth 40 interfaces with a slot 24 in a rotor 20 and the protrusions secure the tooth 40 to prevent it falling out. Although this configuration has less lateral stability than the tooth 30 shown in Figures 3A and 3B it is capable of communicating the forces to the rotor 20 as described above with reference to Figures 3A and 3B.

CLAIMS

1. A grinding unit for use with a grinding machine, the unit comprising:

a rotor having a rim around which a plurality of slots are provided;

a plurality of teeth, each tooth engaging, in use, with one of the slots in the rotor; and

fixing means for retaining each tooth in its associated slot in the rotor.

2. A grinding unit according to claim 1, wherein the tooth engages with the slot on the rotor by means of a slot provided on the tooth.

3. A grinding unit according to claim 1 or claim 2, wherein the radius of the rotor varies around the circumference.

4. A grinding unit according to any one of claims 1 to 3, wherein the rotor is polygonal.

5. A grinding unit according to claim 4, wherein the polygon shape is irregular.

6. A grinding unit according to either claim 4 or claim 5, wherein the rotor has an even number of sides.

7. A grinding unit according any of claims 4 to 6, wherein each slot is provided at a corner of the polygon.

8. A grinding unit according to claim 6, wherein the slots are arranged in diametrically opposed pairs.

9. A grinding unit according to claim 8, wherein the slots in an opposing pair of slots are the same distance from the axis.

10. A grinding unit according to any one of claims 6 to 9, wherein the number of slots is 4, 6, 8, 10 or 12.

11. A grinding unit according to any one of the preceding claims, wherein at least one slot is angled towards the axis of rotation of the rotor.

12. A grinding unit according to any one of claims 1 to 10, wherein at least one slot is angled away from the axis of rotation of the rotor.

13. A grinding unit according to any one of claims 10 to 12, wherein the slots are arranged in two diametrically opposed series, each successive slot in each series having an increased distance from the axis in the direction in which the rotor rotates, in use.

14. A grinding unit according to any one of the preceding claims, wherein each tooth is provided with a through hole that interfaces with one of a plurality of through holes provided in the rotor when the tooth is located in one of the slots in the rotor.

15. A grinding unit according to claim 13, wherein the fixing means is a nut and bolt, the bolt passing through the aligned through holes in the rotor and a respective tooth.

16. A tooth for use with a grinding rotor, the tooth comprising:
a main body; and
a plurality of cutting tips connected to and extending away from the main body.

17. A tooth according to claim 16, wherein the plurality of cutting tips includes at least two tips which are perpendicular to each other.

18. A tooth according to either claim 16 or claim 17, wherein the main body includes a slot for, in use, engaging with a corresponding slot on a rotor.

19. A tooth for use with a grinding wheel, the tooth comprising:
a slot for, in use, engaging with a slot in a rotor, and
at least one cutting face.

20. A tooth according to any of claims 1 to 19, further comprising a channel in its back face.

ABSTRACT

A grinding unit for use with a grinding machine is provided. The grinding unit comprises a rotor which has a rim around which a plurality of slots are provided. Each of the slots in the rotor engages in use with one of a plurality of teeth. The teeth are retained in the rotor by a fix of means.

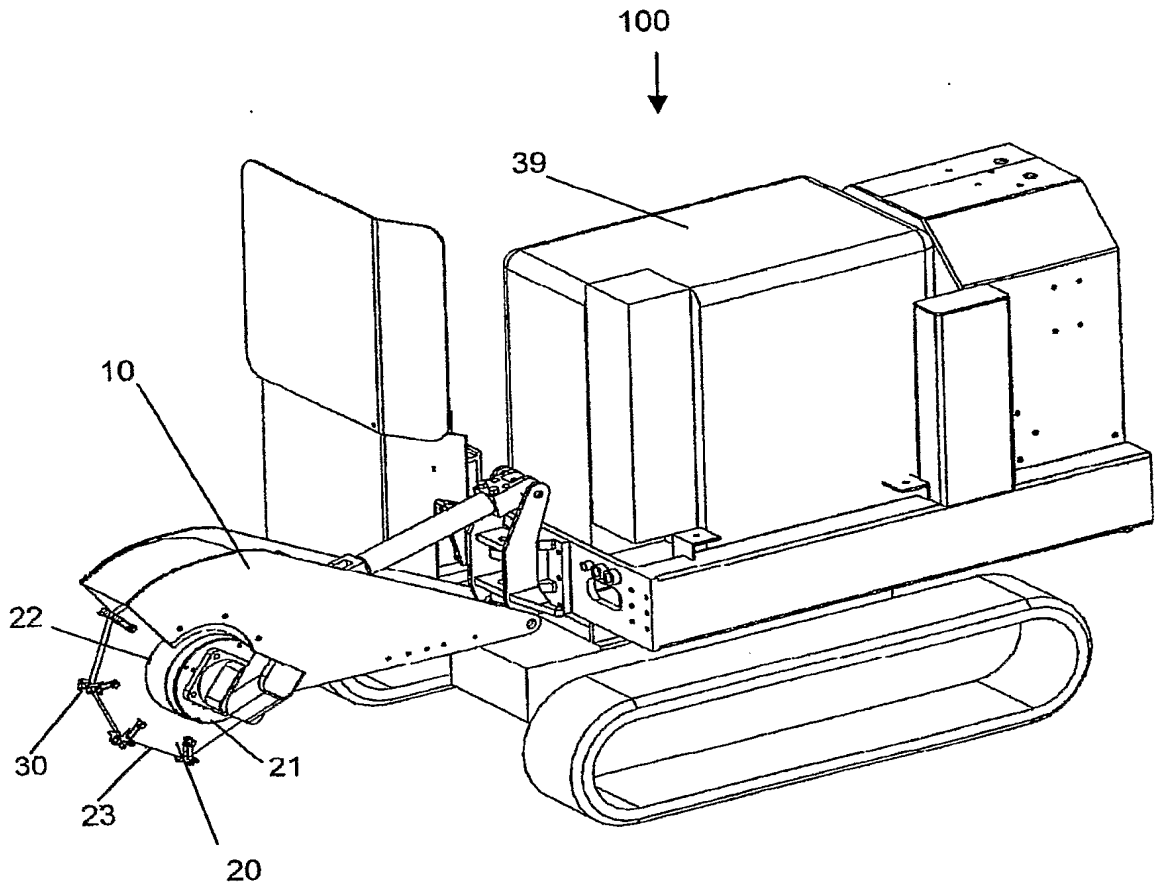

Figure 1

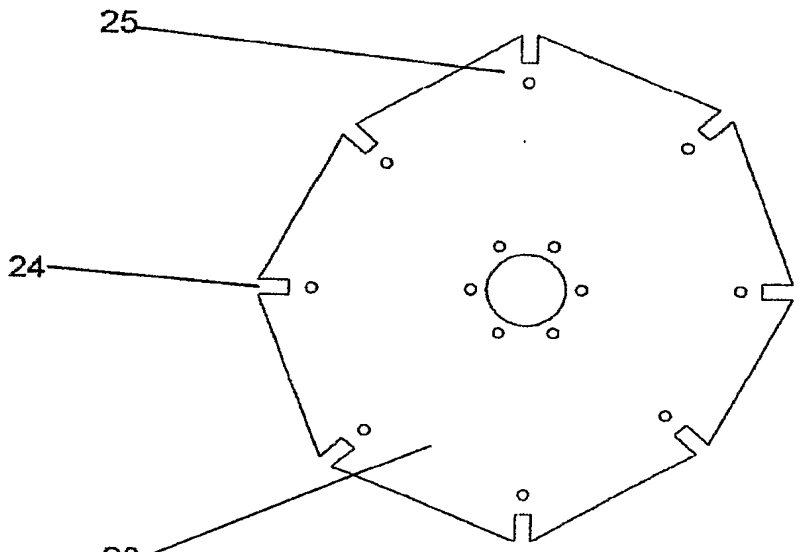

Figure 2A

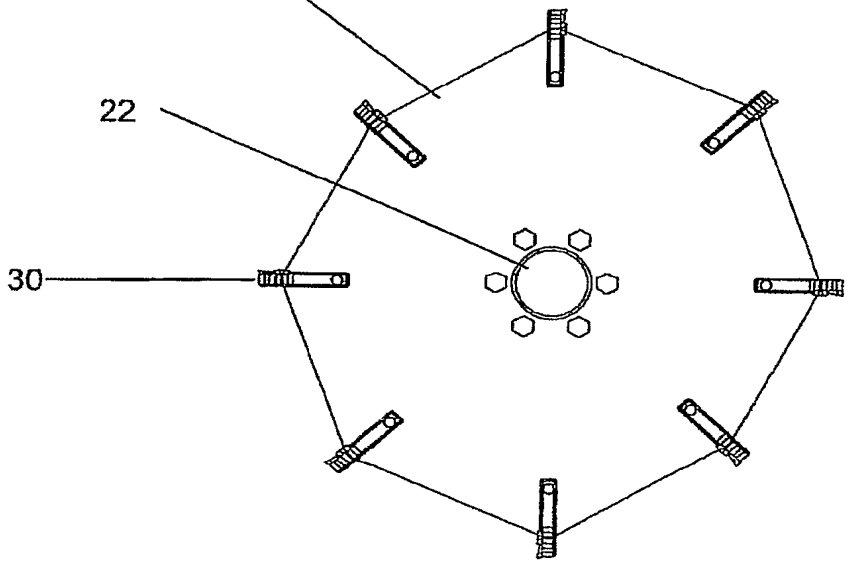

Figure 2B

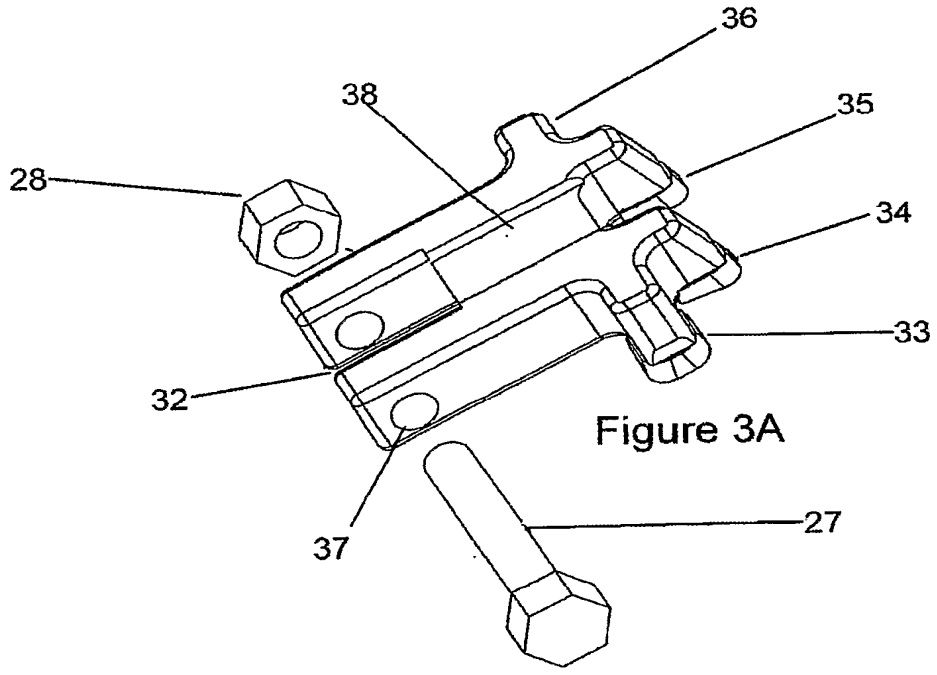

Figure 3A

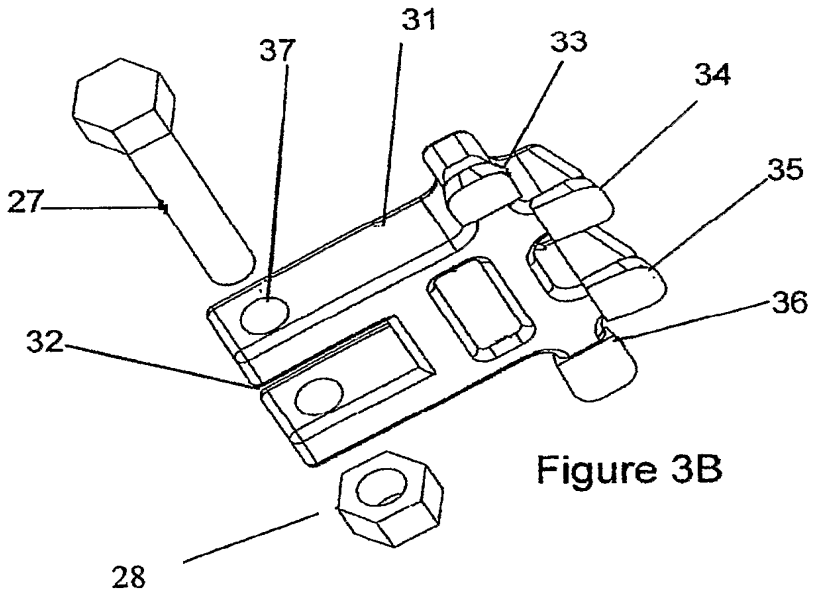

Figure 3B

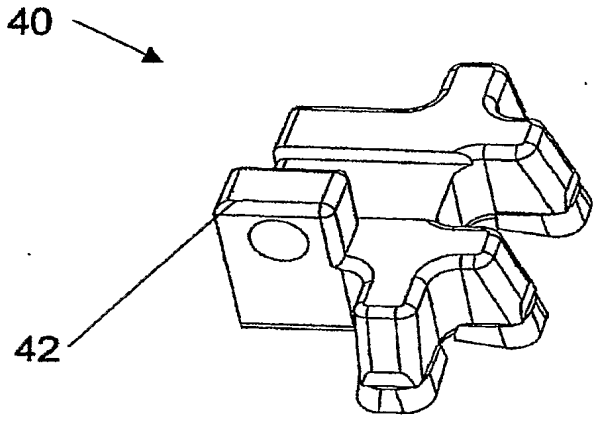

Figure 4A

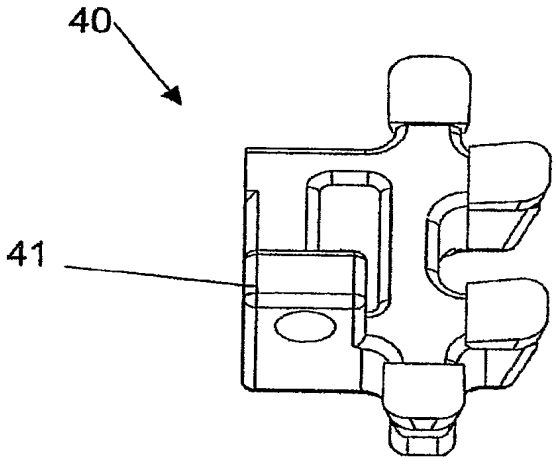

Figure 4B